NOMENCLATURAL CHANGES IN PENNISETUM (POACEAE: PANICEAE)

Joseph K. Wipff

Pure Seed Testing, Inc.
P. O. Box 449
Hubbard, OR 97032 U.S.A.

ABSTRACT

During preparation of the account of *Pennisetum* Rich. for the *Manual of Grasses for North America*, it was determined that three taxa formerly treated under *Cenchrus* L. required new combinations in *Pennisetum*: ***P. setigerum*** (Vahl) Wipff, comb. nov., ***P. pennisetiforme*** (Hochst. & Steud. ex Steud.) Wipff; comb. nov., and ***P. somalensis*** (Clayton) Wipff, comb. nov.

RESUMEN

Durante la preparación del informe de *Pennisetum* Rich. para el *Manual of Grasses for North America*, se vio que taxa tratados previamente como *Cenchrus* L. necesitaban nuevas combinaciones en *Pennisetum*: ***P. setigerum*** (Vahl) Wipff, comb. nov., ***P. pennisetiforme*** (Hochst. & Steud. ex Steud.) Wipff; comb. nov., y ***P. somalensis*** (Clayton) Wipff, comb. nov.

There has been considerable debate concerning the generic limits of *Cenchrus* L. and *Pennisetum* Rich. The predominant character traditionally used to distinguish the two genera is fusion, or lack of fusion, of the bristles (e.g., Henrard 1935; DeLisle 1963; Clayton & Renvoize 1982; Filguerias 1984, Clayton & Renvoize 1986; Watson & Dallwitz 1992), but its variation across the two genera is continuous, making the placement of numerous species arbitrary (Webster 1987). DeLisle (1963), though basing his treatment on the traditional criteria of bristle fusion, recognized the difficulty in the interpretation of this character, and refined his generic criteria with the addition of the follow characters. *Pennisetum* has bristles that are seldom more than 0.2–0.4 mm wide, and the base of the fascicle rarely exceeds 0.5 mm in width; whereas in *Cenchrus*, "the spines usually 0.5 mm or (more) wider, and are generally united for a considerable distance above the base of the bur, with the base itself usually at least 1.5 mm in diameter. These characteristics, although admittedly arbitrary, are used in the present treatment of the genus *Cenchrus*" (DeLile 1963, p. 269). The increase in base diameter is probably a structural response to the fusion and thickening of the bristles and is closely correlated with bristle fusion. The more fusion and thickening of the bristles that occurs the wider the base of the fascicle must be to support them.

Filgueiras (1984), using criteria similar to that of DeLisle (1963), separated the two genera as follows. *Cenchrus* has fused bristles, at least basally, forming a basal disc at least 1 mm in diameter, whereas *Pennisetum* has bristles to the

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base, not forming a disc. Webster (1987) used only the presence of this disc or callus to separate the genera; in *Cenchrus* the callus is pronounced, with the apex flared to form a discoid receptacle, whereas in *Pennisetum* the pronounced callus is absent or, when present not differentiated as in *Cenchrus* species. Webster went on to say that this character allows for the separation of the species along traditional grounds, which is based on bristle fusion. In addition to fusion, Clayton and Renvoize (1986) and Watson and Dallwitz (1992) also mentioned that *Cenchrus* usually had 'spiny' bristles. However, Chase (1920) separated the two genera by bristle type, in addition to fusion: *Pennisetum* has bristles that are usually very slender, not rigid, and are free or rarely united at the very base; whereas *Cenchrus* has rigid bristles that are united below.

Webster (1988) stated that even within a number of species it is open to interpretation as to whether the bristles are fused or the callus flared. In regards to bristle fusion, *Pennisetum ciliare* (L.) Link is extremely variable and has been treated in both *Cenchrus* and *Pennisetum*. Hignight et al. (1991) evaluated 800 accessions of *P. ciliare* collected in South Africa and selected accessions based on extreme differences in morphology, including differences in bristle fusion. Thirteen of the most diverse morphological types were studied for morphology, cytology, and fertility. Five of these diverse morphologically types were used in hybridization studies with a sexual genotype (Bashaw 1969) of *P. ciliare*. Though they found most accessions to have at least some fusion, two of the accessions studied had a complete lack of bristle fusion. These plants were verified at Royal Botanical Gardens, Kew (K) to be *P. ciliare*. Hybridization studies with the sexual genotype showed a close relationship between the plants. Some of the F_1 progeny from the hybridization studies segregated for union of bristles similar to the bristle fusion found in *Cenchrus setigerus* Vahl. Hignight et al. (1991) concluded, "that bristle union is an arbitrary character that varies with genotype and is unreliable for the taxonomic classification of buffelgrass [*P. ciliare*]."

Read and Bashaw (1969) hybridized the same sexual accession of *P. ciliare* with an apomictic accession of *C. setigerus*. The resulting progeny represented a complete intergradation in morphology between the parents. Read and Bashaw concluded that the chromosome homology and cross-compatability of *P. ciliare* and *C. setigerus*, plus the high fertility and morphological intergradation, observed in the F_1 progeny provided overwhelming evidence of a very close relationship between the species and concluded that they belonged in the same genus.

Sohns' (1955) examination of fascicle organization in eight species of *Cenchrus* and six of *Pennisetum* suggests an additional differentiating character: whether the axis of the fascicle is prolonged as a, usually prominent, bristle (*Pennisetum*) or terminates into a spikelet and is not prolonged (*Cenchrus*). Unfortunately, the prolonged bristle in *Cenchrus setigerus* and *P. clandestinum*, although present, is less prominent than in the other species of *Pennisetum* studied and

was overlooked by Sohns. This may be why most subsequent taxonomists considered the presence or absence of the prolonging bristle not to be of generic significance. Also, this character has historically been evaluated as a secondary character in conjunction with bristle fusion (e.g., DeLisle 1963), which is known to be arbitrary in its separation of the genera, and would explain why Sohns' character has appeared to be of little taxonomic value.

Avdulov (1931) and Nunez (1952) reported that the genus *Cenchrus* has a base number of x = 17. Pohl (1980) used chromosome base number as part of his generic criteria. He distinguished the two genera on the following characters. *Cenchrus* has inner bristles that are spine-like or pungent, are usually retrorsely scabrous, and usually have a base chromosome number of $x = 17$; whereas *Pennisetum* has bristles that are not spine-like or pungent and are antrorsely scabrous; and have base chromosome numbers of 5, 7, 8, or 9. However, despite these observations, Pohl later (Pohl & Davidse 1994), without explanation, followed Delisle (1963), Filgueiras (1984), and Clayton and Renvoize (1986) in his generic concept of *Cenchrus* and *Penniseum*.

From the examination of specimens of the following species of *Cenchrus* and *Pennisetum*: *Cenchrus agrimonioides* Trin., *C. biflorus* Roxb., *C. caliculatus* Cav., *C. distichopyllus* Griseb., *C. brownii* Roem. & Schult., *C. echinatus* L., *C. gracillimus* Nash, *C. longispinus* (Hack.) Fern., *C. pilosus* Kunth, *C. palmeri* Vasey, *C. platycanthus* Anderss., *C. spinifex* Cav., *C. tribuloides* L.; *Pennisetum advena* Wipff & Veldkamp, *P. alopecuroides* (L.) Sprengel, *P. annum* Mez, *P. bambusiforme* (Fournier) Hemsley, *P. basedowii* Summerh., *P. chilense* (Desv.) Jackson, *P. ciliare* (L.) Link, *P. clandestinum* Hoch. ex Chiov., *P. complanatum* (Nees) Hemsley, *P. crinitum* (Kunth) Sprengel, *P. distachyum* Rupr., *P. divisum* (Gmel.) Henr., *P. domingense* (Sprengel) Sprengel, *P. durum* Beal, *P. elymoides* (F. Muell.) Gardn., *P. flaccidum* Munro *ex* Griseb., *P. frutescens* Leeke, *P. glaucum* (L.) R. Br., *P. hohenackeri* Steud., *P. hordeoides* (Lam.) Steud., *P. intectum* Chase, *P. karwinskyi* Chase, *P. lanatum* Klotzsch, *P. latifolium* Sprengel, *P. macrostachys* (Brong.) Trin., *P. macrourum* Trin., *P. massaicum* Stapf, *P. mezianum* Leeke, *P. montanum* (Griseb.) Hack., *P. nervosum* (Nees) Trin., *P. occidentale* Chase, *P. orientale* Rich., *P. pauperum* Nees ex Steud., *P. pedicellatum* Trin., *P. pennisetiformis* (Hochst. & Steud. *ex* Steud.) Wipff, *P. peruvianum* (Döll) Trin., *P. petiolare* (Hochst.) Chiov., *P. polystachion* (L.) Schultes, *P. prieurii* Kunth, *P. prolificum* Chase, *P. purpureum* Schumach., *P. ramosum* (Hochst.) Schweinf., *P. rigidum* (Griseb.) Hack., *P. rupestre* Chase, *P. sagittatum* Henr., *P. setaceum* (Forsk.) Chiov., *P. setigerum* (Vahl) Wipff, *P. somalenisis* (Clayton) Wipff, *P. sphacelatum* (Nees) Dur. & Schinz, *P. squamulatum* Fresen., *P. tempisquense* Pohl, *P. thunbergii* Kunth, *P. tristachyon* (Kunth) Sprengel, *P. unisetum* (Nees) Benth., *P. villosum* R.Br. ex Fresn., *P. vulcanicum* Chase, and *P. weberbauri* Mez; as well as cytological examinations of 9 species of *Cenchrus* and 26 species of *Pennisetum*, and in addition to the cytological work already published (for a review see Jauhar 1981;

Wipff 1995; Schmelzer 1998), it is concluded that the generic interpretation that Pohl adopted in 1980 is correct phylogenetically. The degree of fusion of the bristles is generally unreliable at the generic level and should not be used as the primary character in separating the two genera.

The following characters are considered the most important in delineating the two genera:

Pennisetum: 1) bristles are not spine-like or pungent and are antrorsely scabrous (one South American species is both antrorse/retrorse); 2) the axis of the fascicle is prolonged as a, usually, prominent bristle; 3) inner bristles free or fused; and 4) have base chromosome numbers of 5,7,8, or 9.

Cenchrus: 1) inner bristles are spine-like or pungent, and usually retrorsely scabrous (when antrorsely scabrous, the inner bristles are fused and not grooved); 2) the axis of the fascicle terminates in a spikelet; 3) inner bristles are fused, at least at the base; and 4) have a base chromosome number of $x = 17$.

Though, there are still species in *Cenchrus* and *Pennisetum* whose generic placement still needs clarification. For example, *C. myosuroides* Kunth, which has a base number of x = 9 or 10 and a fascicle structure very different from *Cenchrus s.s.*, as well as some South Pacific taxa. The process of obtaining the materials needed to resolve these problems has begun.

New Combinations in the *Pennisetum Ciliare* Complex

Pennisetum setigerum (Vahl) Wipff, comb. nov. BASIONYM: *Cenchrus setigerus* Vahl, Enum. Pl. 2:395. 1805. *Pennisetum vahlii* Kunth, nom. illeg., Rév. Gram. 1:49. 1829. *Pennisetum ciliare* (L.) Link var. *setigerum* (Vahl) Leeke, Z. Naturwiss. 79:22. 1907. *Cenchrus ciliaris* L. var. *setigerus* (Vahl) Maire & Weiler, Fl. Afr. Nord. 1:342. 1952. TYPE: Arabia. *Forsskål* (HOLOTYPE: C!).

Fisher et al. (1954) reported that the type of reproduction was identical between *Pennisetum ciliare* and *Cenchrus setigerus* and that there was continuous variation in morphological characteristics between the two species. He concluded that the two species are members of a single agamic complex. Snyder et al. (1955) also reported that these two species had similar reproductive behavior. Bashaw (1953), after studying the morphology, cytology, and mode of reproduction of *Cenchrus setigerus*, concluded that *C. setigerus* and *Pennisetum ciliare* were "much more closely related than our present classification indicates, perhaps even varieties of the same species." DeLisle (1963), after examining specimens of each taxon from throughout their range, only observed a few specimens that could be considered intermediates and recognized the two taxa as distinct species of *Cenchrus*.

Read and Bashaw (1969) hybridized a sexual genotype of *P. ciliare* with an apomictic genotype of *C. setigerus*. The resulting F_1 population consisted of both sexual and apomictic plants that represented a complete intergradation in morphology between the parents. They also stated that some of the hybrids were so different from either parent that populations from them might be mistaken

for new species. The hybrids were highly fertile and had fewer quadrivalents and more bivalents than either parent. They concluded that the two species were certainly congeneric and possibly conspecific. They noted, however, that "They have been effectively isolated in nature by obligate apomixis and their morphological distinctness was sufficient to permit valid taxonomic treatment at the species level. It is also apparent that with sexuality in buffelgrass [*Pennisetum ciliare*], we are able to produce an unlimited number of distinctly different hybrids. At present it would be convenient to retain specific rank although we feel it would be justifiable to merge the species." (Read & Bashaw 1969, p. 806). Although they recognized both taxa as species of *Cenchrus*, Read and Bashaw stated that it might become necessary in the future to reconsider the generic rank of this entire agamic complex.

Pennisetum pennisetiforme (Hochs. & Steud. ex Steud.) Wipff, comb. nov. (**Figs. 1, 2**). BASIONYM: *Cenchrus pennisetiformis* Hochs. & Steud. ex Steud., Syn. Pl. Glumac. 1:109. 1854. TYPE: Saudi Arabia: Jedda, "In deserto pr. oppid. Deschedda.," 28 Jan 1836, *Schimper 973* [LECTOTYPE, here designated: P!; ISOLECTOTYPES: K! (3 sheets)]. Steudel (1854) cited two collections (*Schimper 973* and *974*) in the protologue. Sheets of these collections were examined from P and found to be similar. *Schimper 973* was chosen as the lectotype because duplicate sheets are known to exist at K, whereas presently there is only one sheet of *Schimper 974* known to be in existence.

Delisle (1963) considered *Cenchrus pennisetiformis* as part of *C. ciliaris*. Clayton (1982) reported that the boundary between *C. ciliaris* and *C. pennisetiformis* was indistinct, but that the species could be separated as follows: *Cenchrus pennisetiformis* has inner bristles basally connate for 1–2.5 mm of their length, is usually annual (short-lived perennial), smaller in stature and found mostly in sub-desert grasslands; whereas, *C. ciliaris* has the inner bristles basally connate for (0–)0.5–1.5 mm of their length, is a stout perennial, with or without rhizomes, usually forming a hard, knotty, sometimes almost woody base, and is found in deciduous bushland and wooded grasslands.

Pennisetum somalensis (Clayton) Wipff, comb. nov. BASIONYM: *Cenchrus somalensis* Clayton, Kew Bull. 32:3. 1977. TYPE: SOMALI REPUBLIC: Erigavo, 5000-7000 ft [1524–2133 m], under shade of bush and trees, Nov 1938, *A.S. McKinnon S221* (HOLOTYPE: K!).

Clayton (1977) reported that *C. somalensis* and *C. pennisetiformis* were closely related, but that *C. somalensis* is a densely tufted perennial with inrolled leaves about 1 mm wide; whereas, *C. pennisetiformis* is an annual, or short-lived perennial, with flat leaf blades, 2–5 mm wide.

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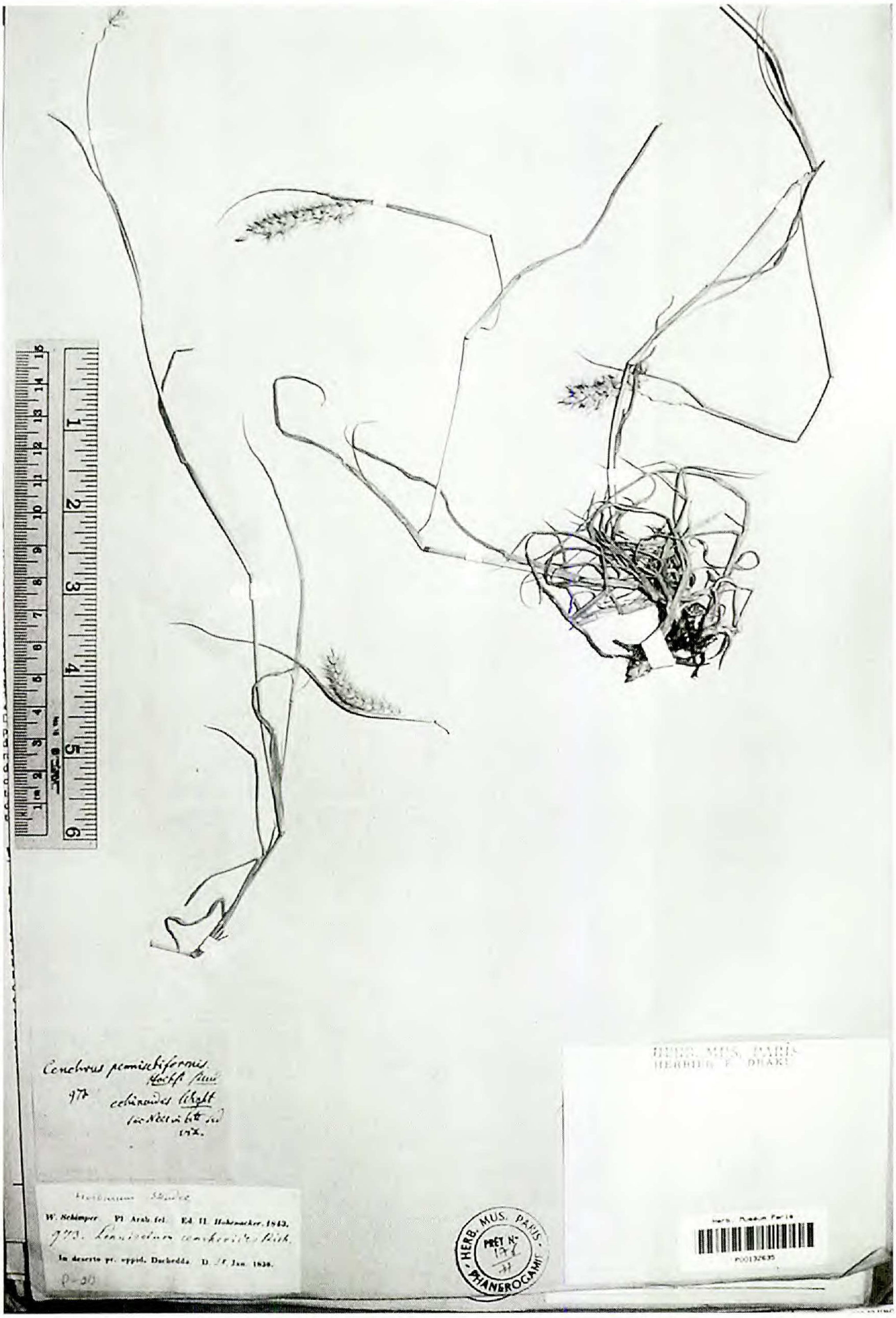

FIG. 1. Photograph of the lectotype (P) of *Pennisetum pennisetiforme*.

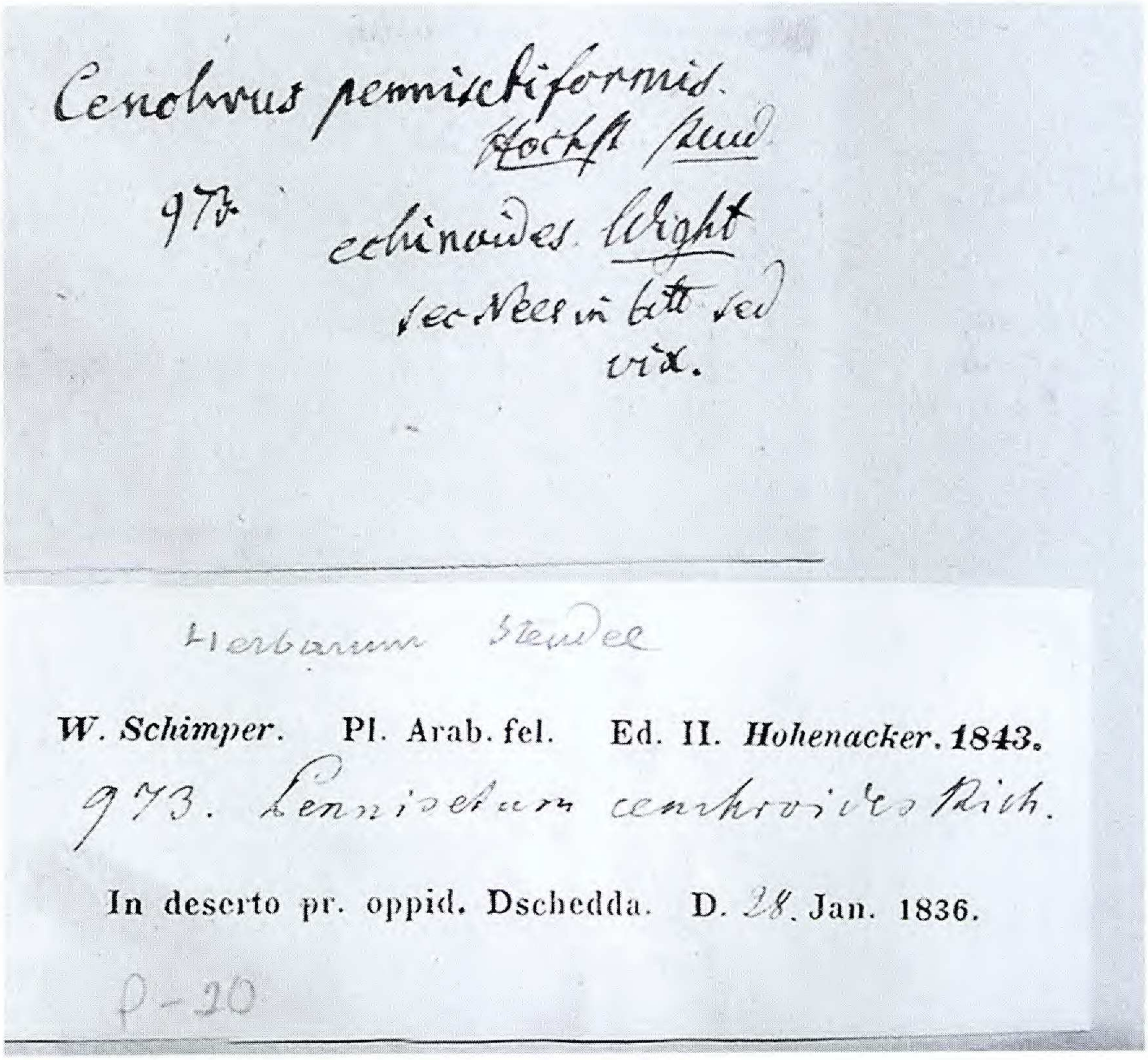

FIG. 2. Photograph of the label of the lectotype (P) of *Pennisetum pennisetiforme*.

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